Attachment 16
Technical Memorandum – Evaluation of Leachate Travel Time from the Proposed Expansion to Nearest Private Wells

RMT

Technical Memorandum

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To: RMT File

HJH HJH for John Rice

From: Hans Hinke and John Rice, RMT

Project No.: 20655.41

Subject: **Veolia Emerald Park – Time for leachate to reach private wells in worst case closure conditions.**

1 – Leachate head required for positive gradient
Based on the low water table map (august 2, 2007 observations) conditions, there will be inward gradient with groundwater flowing in towards the landfill cell. The lowest groundwater level observation was 767.47 ft (MW 301A). Planned leachate sump elevation is approximately 715 ft. In order to make an outward gradient for leachate to flow out of the landfill, the leachate head would need to be Approximately 52 ft above the leachate sump. This elevation of leachate is not probable during operation of the landfill.

2 – Worst Case – Number of years to reach private well
Assuming a worst case scenario, i.e. that groundwater gradients revert to pre-landfill conditions. The controlling factor in travel time to nearby private water wells will be the hydraulic conductivity and thickness of confining clay liner and confining clay soil stratum. For the purpose of this analysis, it was assumed that the travel time through granular outwash deposits and limestone bedrock would be negligible compared to the confining unit. Nearby private wells that would be considered first effected are PW-D, PW-E, and PW-F. Vertical movement of groundwater was assumed, with groundwater traveling down from the leachate sump to the outwash deposits.
Vertical hydraulic conductivity (K) of the clay liner is conservatively assumed to be 1x10-7 cm/sec. Kv of the native confining stratum is estimated to be 2.0x10-7 cm/sec, i.e. one tenth of the average measured Kh value The Kh value was measured at site monitoring wells, the three most representative wells screened in the interval of concern are (MW-125D, MW-131D, and MW-304C). The effective porosity was assumed to be 20 percent. Liner thickness was set at 4 ft, and the minimum native confining layer stratum between liner sump and silty sand glacial outwash is 37 ft. The average downward gradient of the measured peizometer nests (MW-125C & D, MW 131C&D, and MW-304B&C) was 0.17 ft/ft and was used to control flow in the calculation.
Calculated travel time vertically through the liner and confining stratum was 240 years.

Veolia Emerald Park

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Calculation of confining layer thickness
- clay liner defined as 4ft.
- native clayey soil stratum extends from bottom of leachate sump EL 715ft to top of silty sand glacial outwash at EL 681ft for thickness of 34ft

Calculation of Vertical Hydraulic Conductivity (K_v)
- clay liner defined as 1×10^{-7} cm/sec or better (less)
- native clayey soil stratum horizontal hydraulic conductivity (K_h) was measured by slug testing for many locations in the field. The three locations near the leachate sump were used to determine areage ~~vert~~ horizontal conductivity for the unit

MW-125D 3.2×10^{-6}
MW-131D 2.0×10^{-7} $\bar{K}_h = 2.0\times10^{-6}$ cm/sec ✓
MW-304C 2.7×10^{-6}

vertical hydraulic conductivity was assumed to be $1/10^{th}$ of horizontal
$K_v = 2.0\times10^{-7}$ cm/sec

Determine hydaulic gradient at worst case conditions (leachate rises to existing groundwater levels). Using peizometric surfaces in nested peizometers, the most representative comparisons are from within the native confining layer to within the outwash aquifer

MW-125C&D - 3.28ft/43ft = 0.076
MW-131C&D - 16.82ft/39ft = 0.43 $\bar{i} = 0.17$ ft/ft ✓
MW-304B&C - 0ft/4.8ft = 0.

Determine Vertical conductivity of confining unit in serres

$$\bar{K}_v = \frac{L}{\frac{L_a}{K_a}+\frac{L_b}{K_b}} = \frac{38ft}{\frac{4ft}{1\times10^{-7}cm/sec}+\frac{34ft}{2.0\times10^{-7}cm/sec}} = 1.8\times10^{-7}\ cm/sec$$ ✓

Determine rate of travel based on Hydraulic Conductivity, Hydraulic gradient and effective porosity (20%)

$$\frac{Ki}{n} = \frac{(1.8\times10^{-7})(0.17)}{0.20} = 1.53\times10^{-7}\ cm/sec$$ ✓

Determine travel time for $\frac{38'\ (1159\ cm)}{1.53\times10^{-7}\ cm/sec} =$ 240 years ✓